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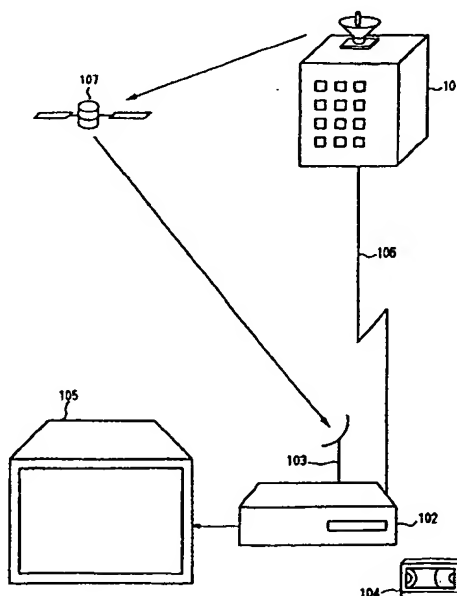
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(54) Receiving controlled-access broadcast signals

(57) An apparatus and method for transferring from
a broadcaster (101) to a receiver (102) a limited repro-
duction right in data. A signal indicating the limited
reproduction right is transmitted by the broadcaster
(101) and stored (104) by the receiver (102) with the
data. The receiver (102) reproduces and processes the
data as a function of this signal.

Fig. 1



optic network or the like.

[0013] Satellite 107 is a satellite broadcast signal relay station that receives signals from broadcasting station 101 and relays the signals to antenna 103. Antenna 103 receives signals from satellite 107 and supplies the signals to receiving system 102. Alternatively, satellite 107 can be replaced by any of a number of other transmission media, such as a land-based broadcast system, a cable television system, a fiber optic network or the like.

[0014] Receiving system 102 receives video signals and access-control signals supplied by broadcasting station 101 and processes (e.g. descrambles, decodes, and records) the signals. Typically, video signals are recorded on a storage medium and subsequently reproduced for display. Alternatively, video signals are recorded on a storage medium and processed for display to a user substantially simultaneously. Access-control signals are stored in a memory or, alternatively, recorded on a storage medium which may be the same storage medium on which the video signals are recorded. In a preferred embodiment, receiving system 102 is adapted to receive a storage cassette 104 containing a tape on which video and access-control signals are recorded. Alternatively, storage cassette 104 comprises a tape for storing video signals and a separate memory, such as a memory chip included therein, for storing access-control signals. In other embodiments, receiving system 102 is adapted to receive any of a number of other storage media, such as a video disc, a magnetic media diskette, a compact disc or the like. Video display 105, which preferably is a conventional display device, is coupled to and receives video signals from receiving system 102 for display to a user.

[0015] In a preferred recording mode of operation, broadcasting station 101 transmits video signals to satellite 107 which relays the signals to antenna 103 from which the video signals are coupled to receiving system 102. Also, broadcasting station 101 transmits access-control signals through communication link 106 to the receiving system. Receiving system 102 processes and records the video signals as a function of the access-control signals.

[0016] In a preferred reproduction mode of operation, the receiving system retrieves the previously stored access-control signals and uses those access-control signals to control the reproduction and processing of the previously recorded video signals. The video signals are supplied to video display 105 or to another peripheral device (not shown).

[0017] An alternate satellite television broadcasting system according to the present invention comprises each of the elements described above except that only one of communication link 106 and satellite 107 is included. The alternate system is otherwise interconnected as in the above-described embodiment. Through the single transmission medium, broadcasting station 101 transmits both video signals and access-control signals to receiving system 102.

[0018] In another variation, receiving system 102 transmits program requests, payment information, or other signals to broadcasting station 101 through one of the transmission media. Typically, communication link 106 is used for this purpose.

[0019] A first embodiment of the controlled-access broadcast digital video signal receiving system 102 according to the present invention is illustrated in Fig. 2 as system 102A. Receiving system 102A, is adapted for receiving, descrambling, enciphering, recording, deciphering and decoding digital video signals; and is comprised of a tuner 20, a descrambler 21A, an encipherer 22, a recording/reproducing section 23A, a decipherer 25, a decoder 26, an access controller 28A, a user interface 30, and a modem 31.

[0020] Tuner 20 receives input digital video signals, selects particular digital video signals, and supplies the selected signals to descrambler 21A. Preferably, input digital video signals are satellite broadcast digital video signals acquired by satellite antenna 103 which is coupled to tuner 20. Alternatively, input digital video signals are acquired from another transmission medium that is coupled to tuner 20. Preferably, a user controls tuner 20 to select signals from among different input digital video signals. The selected video signals include a time reference signal and a date reference signal.

[0021] Descrambler 21A is coupled to tuner 20 and descrambles scrambled digital video signals supplied therefrom. As is well known in the art, transmitted video signals are commonly scrambled or coded by a signal provider to prevent unauthorized reception of the video signals. Descrambler 21A supplies an unscrambled version of the digital video signals to encipherer 22. Further, descrambler 21A is coupled to a clock 27 to supply the received time reference signal and the date reference signal thereto.

[0022] Encipherer 22 is coupled to descrambler 21A, recording/reproducing section 23A, and access controller 28A. When enabled by the access controller, encipherer 22 encrypts, according to an encryption key, descrambled video signals supplied by descrambler 21A to produce encrypted video signals. The encrypted video signals are supplied to recording/reproducing section 23A for recording. However, the encrypted video signals cannot be displayed by ordinary means. It is contemplated that the encryption key is prestored in encipherer 22, or is supplied by access controller 28A, or is included in the video signals or in the access-control signals supplied by broadcasting station 101. When disabled by access controller 28A, encipherer 22 passes descrambled video signals from descrambler 21A directly to section 23A without encryption.

[0023] Recording/reproducing section 23A, through a record/playback head 24, or the like, records on storage medium 40 video signals supplied by encipherer 22. Section 23A, through head 24, also reads previously recorded video signals from storage medium 40 and supplies the reproduced video signals to decipherer 25.

[0033] The configuration of the present invention is compatible with many different sequences of signal transfer between broadcasting station 101 and receiving system 102A. Examples of useful signal transfer sequences, implemented in different modes of operation of the present invention, will be described in detail below. Through the different modes of operation, video programs are securely transferred between a broadcaster and a consumer for recording, but the consumer's ability to display the programs can be subjected to limitations.

[0034] In a first video-on-demand mode, a user enters into user interface 30 a request for a specific video program. User interface 30 transmits this request to access controller 28A, which, in turn, communicates the user's request through modem 31 and communication link 106 to broadcasting station 101. The broadcasting station transmits the requested video program to satellite 107 which relays the video program to antenna 103 and supplies the video signals representing this program to tuner 20. It is expected that several video signals are coupled to tuner 20, which selects the particular video signals comprising the requested video program and supplies these selected video signals to descrambler 21A. The descrambler descrambles these broadcast video signals and supplies a descrambled version of the video signals to encipherer 22. Descrambler 21A also supplies a time reference signal and a date reference signal, which accompany the video program transmission, to clock 27.

[0035] Additionally, broadcasting station 101 communicates access-control signals through communication link 106 and modem 31 to access controller 28A for storage in access condition memory 29. The access-control signals serve to define the conditions or limitations, if any, upon the usage of the requested video program. In general, a user can either purchase or rent a particular video program from a broadcaster. In a prepayment method of purchase, a user pays for a video program and subsequently requests that the broadcaster transmit the program to the user's video receiving system. Broadcasting station 101 transmits the requested program and an access-control signal indicating that the video program can be unconditionally recorded and reproduced (FULL ACCESS). Access controller 28A stores the FULL ACCESS signal in access condition memory 29 to disable encipherer 22. Hence, descrambled video signals of the video program are supplied by descrambler 21A through encipherer 22, without encryption, to recording/reproducing section 23A, whereat the descrambled and unencrypted video signals are recorded on storage medium 40.

[0036] In a postpayment method of purchase, wherein a user elects to pay for a video program after it has been received by the user's receiving system, broadcasting station 101 transmits the particular video program to receiving system 102A along with an access-control signal indicating that the video program cannot be

reproduced (NO REPRO). Access controller 28A stores the NO REPRO signal in access condition memory 29 and enables encipherer 22, causing it to encrypt, according to an encryption key, descrambled video signals of the video program supplied by descrambler 21A. Encipherer 22 supplies encrypted video signals to recording/reproducing section 23A, whereat the encrypted video signals are recorded on storage medium 40.

[0037] It is contemplated that the user subsequently purchases the video program from the broadcaster. Upon payment, broadcasting station 101 transmits an access-control signal to access controller 28A indicating that the recorded video program can be reproduced (REPRO OK), and this REPRO OK signal replaces the previously stored NO REPRO signal in memory 29. When the encrypted video signals subsequently are played back from storage medium 40, they are supplied to decipherer 25 which is enabled by the stored REPRO OK signal to decrypt the reproduced video signals.

[0038] In a second prepayment method of purchase, similar to the postpayment method, the user pays for the selected program prior to its transmission, but broadcasting station 101 first transmits the selected program to receiving system 102A along with a NO REPRO signal. Access controller 28A causes encipherer 22 to encrypt the video signals of the video program and the encrypted signals are recorded on storage medium 40 while the NO REPRO signal is stored in access condition memory 29. Upon completion of the video program transmission, broadcasting station 101 transmits a REPRO OK signal; and access controller 28A replaces the stored NO REPRO signal with the REPRO OK signal. Thus, the video program is recorded in encrypted form but the user can reproduce and decrypt the program an unlimited number of times. This second prepayment method has the advantage of producing video recordings that can only be reproduced in devices having compatible decryption capabilities.

[0039] Alternatively, a user can purchase the right to reproduce a video program a certain number (N) of times. The user thus "rents" the video program for N reproductions. In one mode, the user enters a request into user interface 30 to rent a video program for N reproductions. User interface 30 transmits the request to access controller 28A which forwards the request through modem 31 and communication link 106 to broadcasting station 101. Broadcasting station 101 transmits the requested video program along with an access-control signal indicating that the video program can only be reproduced N times (REPRO N TIMES). The access controller receives the REPRO N TIMES signal and stores it in access condition memory 29. The video program is received by tuner 20 and supplied to descrambler 21A which descrambles the video program and supplies descrambled video signals to encipherer 22. The encipherer, which is enabled by the access controller, encrypts the descrambled video signals, and

medium 40.

[0050] Subsequently, but prior to date Y, the user selects a video program from the requested video programming stored on storage medium 40 and pays the fee to rent the selected program for a particular rental term. Upon payment, broadcasting station 101 transmits the access-control signal indicating the appropriate rental condition to access controller 28A which replaces the previously stored NO REPRO signal in memory 29. Hence, the ERASE ON DATE Y signal remains stored in access condition memory 29.

[0051] Illustrative video signal reproduction modes of operation of receiving system 102A now will be described. The process is initiated when a user enters a command into user interface 30 to reproduce a prestored video program recorded on storage cassette 104A. The user interface transmits the command to access controller 28A which retrieves the access-control signal stored in access condition memory 29 of the storage cassette. The operation of decipherer 25 is controlled as a function of the particular access-control signal(s) that is retrieved.

[0052] If, for example, the retrieved signal is a FULL ACCESS signal, then access controller 28A disables decipherer 25. Recording/reproducing section 23A recovers video signals from storage medium 40 and supplies the reproduced video signals to decipherer 25, which passes the video signals to decoder 26. As described above, the reproduced video signals are unencrypted; and decoder 26 decodes the video signals and supplies uncoded video signals to video display 105.

[0053] If the NO REPRO signal is retrieved from access condition memory 29, access controller 28A disables the operation of decipherer 25. However, unlike the FULL ACCESS signal case, the video signals stored on storage medium 40 are encrypted. Hence, recording/reproducing section 23A reproduces encrypted video signals which are supplied to decipherer 25 to be passed directly to decoder 26 without decryption. The decoder decodes the encrypted video signals to produce uncoded but encrypted video signals which are supplied to video display 105. As a result, the video display either cannot display the video signals at all or can only display a distorted version of the original video program.

[0054] As a further alternative, access controller 28A may retrieve a REPRO OK signal from access condition memory 29 to enable the operation of decipherer 25. Recording/reproducing section 23A reproduces the encrypted video signals stored on storage medium 40 and supplies the encrypted signals to enabled decipherer 25 which decrypts the video signals and supplies unencrypted video signals to decoder 26. The decoder decodes the video signals and supplies the resulting uncoded and decrypted video signals to video display 105 for display. Because the video signals are uncoded and decrypted, video display 105 displays the repro-

duced video program without distortion.

[0055] As yet another alternative, when access controller 28A retrieves a REPRO N TIMES signal from access condition memory 29, the access controller 28A determines whether the number N is greater than a predetermined threshold value (e.g. zero). If the number N is not greater than the threshold value, then access controller 28A disables operation of decipherer 25 and reproduction of the stored video signal proceeds as in the NO REPRO signal case. On the other hand, if the number N is greater than the threshold value, then access controller 28A enables decipherer 25 and reproduction of the stored video signal proceeds as in the REPRO OK signal case.

[0056] After the video signal is reproduced from storage medium 40, if the number N is greater than the threshold value, access controller 28A subtracts one from the value of N to produce a new value N and writes a new REPRO N TIMES signal, utilizing the new value N, into access condition memory 29 whereat the previously stored REPRO N TIMES signal is replaced by the new REPRO N TIMES signal. According to this procedure, the particular video signals stored in storage medium 40 to which the REPRO N TIMES signal corresponds are only reproduced the number of times represented by the number N. The value N stored in access condition memory 29 thus reflects the remaining number of permitted reproductions of the particular video signals. Since the access condition memory is provided in the same storage cassette 104A as storage medium 40, and the video signals are encrypted on the storage medium, the video signals can only be reproduced for display N times even if the cassette is loaded into another receiving system, at least until a new access-control signal is stored.

[0057] When, as described above, a video program is rented for only a certain period of time, access controller 28A retrieves the corresponding access-control signal from access condition memory 29 and also receives a clock signal and a date signal from clock 27. The clock signal and the date signal are compared to the retrieved access-control signal, and if the particular condition expressed in the access-control signal is satisfied such that reproduction is allowed, then decipherer 25 is enabled and reproduction of the stored video signals proceeds as in the REPRO OK case. However, if the condition expressed by the access-control signal is not satisfied such that reproduction of the video signals is not allowed, then the decipherer is disabled and reproduction of the stored video signals proceeds as described with respect to the NO REPRO signal.

[0058] For example, when access controller 28A retrieves a REPRO UNTIL DATE Y signal from access condition memory 29, it compares the date signal from clock 27 to the date Y. If the date from clock 27 is prior to date Y, then the access controller enables the operation of decipherer 25 to decrypt the reproduced, encrypted video signals. In a similar fashion, when the

broadcast digital video signal receiving system 102C according to the present invention is illustrated in Fig. 4. Receiving system 102C, is adapted for receiving, descrambling, decoding, recording, and reproducing digital video signals and is similar to the
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[0069] Fig. 4 differs from Fig. 2 in that descrambler 21C of receiving system 102C is coupled to access controller 28C, recording/reproducing section 23A, and decoder 26; and encipherer 22 and decipherer 25 are not provided as separate circuits. When enabled by access controller 28C, descrambler 21C descrambles video signals supplied by tuner 20 and supplies an unscrambled version of the digital video signals to recording/reproducing section 23A. Also, when enabled by the access controller, descrambler 21C descrambles video signals reproduced by recording/reproducing section 23A and supplies an unscrambled version of the digital video signals to decoder 26. When disabled by access controller 28C, descrambler 21C passes scrambled video signals from tuner 20 directly, without encryption, to section 23A and also passes video signals reproduced by the recording/reproducing section directly, without decryption, to decoder 26. Scrambled video signals can be recorded but they cannot be displayed in scrambled form.

[0070] It will be appreciated that access controller 28C functions in the same general manner as access controller 28A, except that descrambler 21C is controlled in accordance with the access-control signals rather than encipherer 22 and decipherer 25.

[0071] At those aforescribed operational steps where access controller 28A enables encipherer 22, access controller 28C disables descrambler 21C to pass scrambled signals to the recording/reproducing section; and where access controller 28A disables encipherer 22, access controller 28C enables descrambler 21C to supply descrambled signals to the recording/reproducing section. However, in the operational steps where access controller 28A enables decipherer 25, access controller 28C similarly enables descrambler 21C to descramble the signals reproduced by the recording/reproducing section. Where access controller 28A disables decipherer 25, access controller 28C similarly disables descrambler 21C to pass to decoder 26 signals reproduced by the recording/reproducing section.

[0072] In an alternate embodiment of receiving system 102C, access-control signals, transmitted by broadcasting station 101 along with video signals, are received through antenna 103 and supplied by tuner 20 to descrambler 21C for descrambling and for coupling to access controller 28C.

[0073] A still further embodiment of the controlled-

access broadcast digital video signal receiving system 102D according to the present invention is illustrated in Fig. 5. Receiving system 102D is seen to be a combination of portions of receiving system 102C and receiving system 102B (Fig. 3). Similar to receiving system 102B, receiving system 102D stores access-control signals and video signals in the same storage medium 40 of storage cassette 104B. Recording/reproducing section 23B supplies the reproduced video signals to descrambler 21C and supplies the reproduced access-control signals to access controller 28D.

[0074] It will be appreciated that the modes of operation of receiving system 102D are substantially similar to the modes of operation of receiving system 102C with the following illustrative exceptions. Access controller 28D functions in the same manner as access controller 28C, except that access-control signals are stored in storage medium 40 instead of in a separate access condition memory. Recording/reproducing section 23B functions in the same manner as section 23A except that section 23B additionally records access-control signals on and reproduces access-control signals from storage medium 40. The reproduced access-control signals are supplied from recording/reproducing section 23B to access controller 28D.

[0075] Similar to the alternate embodiment discussed in conjunction with Fig. 4, access-control signals, transmitted by broadcasting station 101 along with video signals, are received through antenna 103 and supplied by tuner 20 to descrambler 21C for descrambling; and the descrambled access-control signals are supplied to access controller 28D. It is seen that access controller 28D receives access-control signals from recording/reproducing section 23B and either from modem 31 or from descrambler 21C, or from both.

[0076] Fig. 6 is a flow diagram of a preferred mode of operation of receiving system 102A of Fig. 2, as controlled by access controller 28A, wherein a user orders from a broadcaster a limited or an unlimited right (as may be desired) to reproduce a video program. The user initiates the process by entering a request for a particular video program at user interface 30. The process begins at step S60, where access controller 28A causes modem 31 to connect to broadcasting station 101.

[0077] Access controller 28A transmits identification information through modem 31 and communication link 106 to broadcasting station 101 which checks the identification information against a subscription list and determines whether the user has subscribed to the broadcasting station's service, as represented by inquiry S61. If the user is not subscribed, the broadcasting station terminates the connection with receiving system 102A in step S62.

[0078] If the user is subscribed, inquiry S61 is answered in the affirmative and operation continues to inquiry S63, which polls the user to determine whether or not the video program is to be purchased. If the user

and supplied for display to video display 105.

[0092] If the retrieved access-control signal is not the NO REPRO signal, as represented by a negative answer to inquiry S81, inquiry S82 determines whether the access-control signal is the REPRO N TIMES signal. If so, processing proceeds with step S94. Otherwise, processing proceeds to inquiry S83. In step S94, access controller 28A decrements N by one, debiting the single reproduction which will immediately follow. Further, the REPRO N-1 TIMES signal is stored in access condition memory 29, replacing the access-control signal previously stored there, and processing proceeds to step S97 to reproduce and decrypt the video signal, described above.

[0093] If the retrieved access-control signal is not the REPRO N TIMES signal, inquiry S83 is made to determine if the access-control signal is the REPRO UNTIL DATE Y signal. If so, processing proceeds to inquiry S87. Otherwise, processing proceeds to inquiry S84. Inquiry S87 compares the date signal supplied by clock 27, indicating the current date, with date Y. If the current date is prior to date Y, then processing proceeds to step S97, described above. Otherwise, processing proceeds to step S90, whereat access controller 28A determines that the applicable condition has not been satisfied and therefore no video signal reproduction is authorized. The access controller thereafter terminates the connection with broadcasting station 101.

[0094] If the retrieved access-control signal is neither the NO REPRO nor the REPRO N TIMES nor the REPRO UNTIL DATE Y signal, inquiry S84 determines if the access-control signal is the REPRO OK signal. If it is, processing proceeds with step S97, described above. Otherwise, processing advances to inquiry S85 whereat access controller 28A determines if the access-control signal is the FULL ACCESS signal. If so, processing proceeds with step S96. Otherwise, processing proceeds with step S92.

[0095] In step S92, access controller 28A determines that it has failed to recognize the particular access-control signal stored in condition access memory 29, if any. Lacking a recognizable access-control signal, no video signal reproduction is authorized. Access controller 28A terminates the connection with broadcasting station 101. It should be appreciated that step S92 can be replaced with additional access-control signal definitions to provide further processing and access-control signal permutations.

[0096] In step S96, access controller 28A disables decipherer 25, and recording/reproducing section 23A reproduces the selected video program from storage medium 40. The reproduced video program passes through decipherer 25 for decoding by decoder 26, and is supplied to video display 105 for display.

[0097] If the retrieved access-control signal is the NO REPRO signal and payment of the full purchase price is not made, inquiry S88 is answered in the negative and the process advances to inquiry S89, which queries the

user to determine if the fee for N viewings of the video program will be paid. If the fee for N viewings of the video program is paid, then broadcasting station 101 transmits the REPRO N TIMES signal via communication link 106 and modem 31 to access controller 28A, and processing proceeds with step S94, described above. Otherwise, processing proceeds to inquiry S91 which queries the user to determine if the fee for rental of the video program until date Y will be paid. If the fee for such a rental is paid, then processing proceeds with step S95. Otherwise, processing proceeds with step S90, described above.

[0098] In step S95, broadcasting station 101 transmits the REPRO UNTIL DATE Y signal via communication link 106 and modem 31 to access controller 28A which stores the REPRO UNTIL DATE Y signal in access condition memory 29, replacing the NO REPRO signal, and processing proceeds to step S97, described above.

[0099] Those of ordinary skill in the art will readily appreciate the modifications to be made to the flow diagrams of Figs. 6 and 7 to control the operation of the controlled-access broadcast video signal recording systems shown in Figs. 3, 4 and 5. Hence, in the interest of brevity, further description of such modified flow diagrams is not made.

[0100] Although illustrative embodiments of the present invention and modifications thereof have been described in detail herein, it is to be understood that this invention is not limited to these precise embodiments and modifications, and that other modifications and variations may be effected therein by one skilled in the art. For example, it is contemplated that a broadcast video program can be processed by an apparatus embodying the present invention for display to a user without a preceding or simultaneous recording of the video program.

Claims

1. Apparatus for receiving digital broadcast signal which is scrambled, the apparatus comprising:

receiving means (20) for receiving said digital broadcast signal;

descrambling means (21A), coupled to said receiving means (20), for descrambling said received digital broadcast signal;

encrypting means (22) for encrypting said descrambled digital broadcast signal in order to record said digital broadcast signal on a recording medium; and

decrypting means (25) for decrypting said encrypted broadcast signal which is reproduced from said recording medium.

2. Apparatus according to claim 1, wherein said broadcast signal includes an access-control signal, said encrypting means being controlled in response to said access-control signal.

Fig. 1

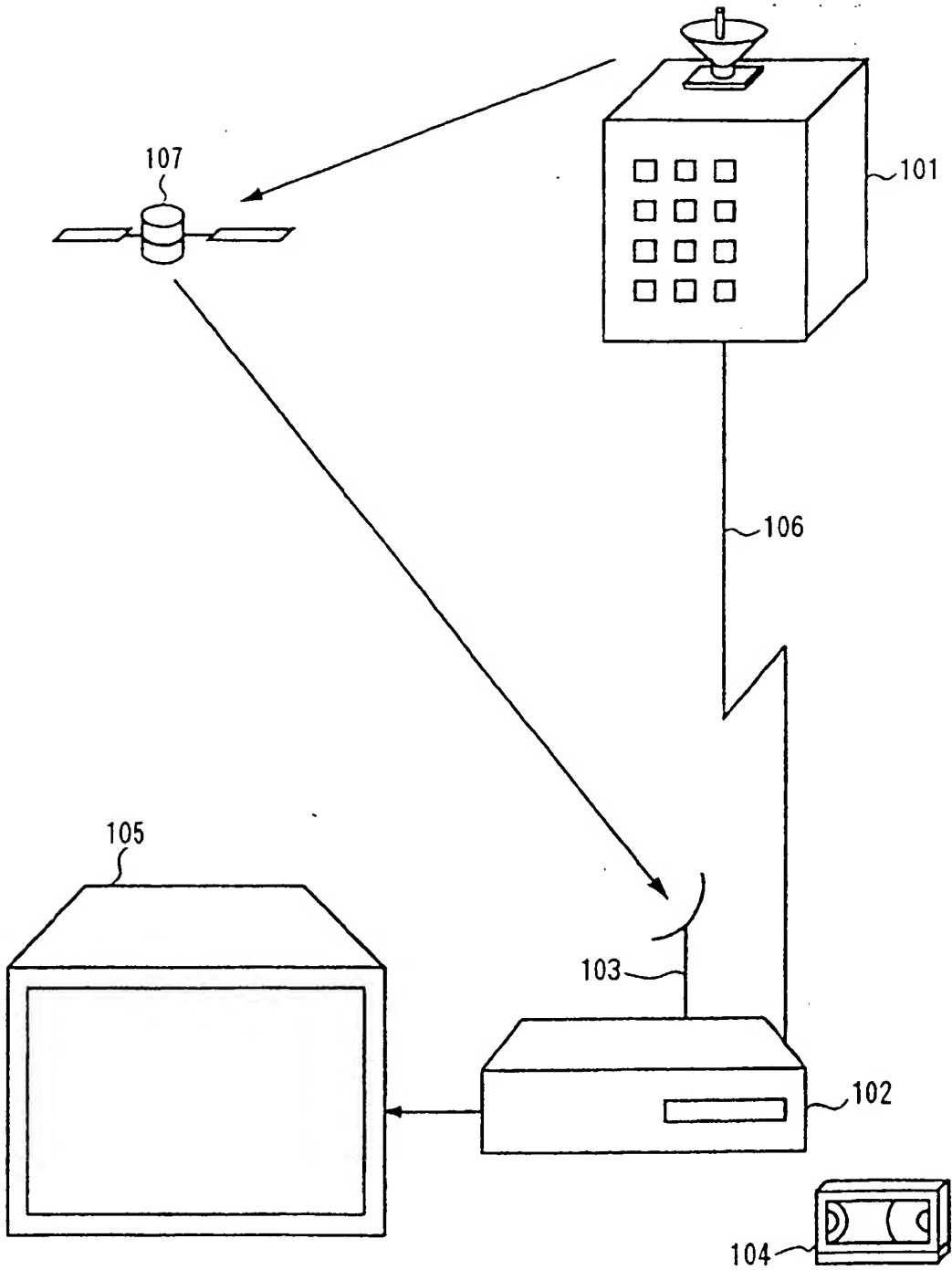


Fig. 3

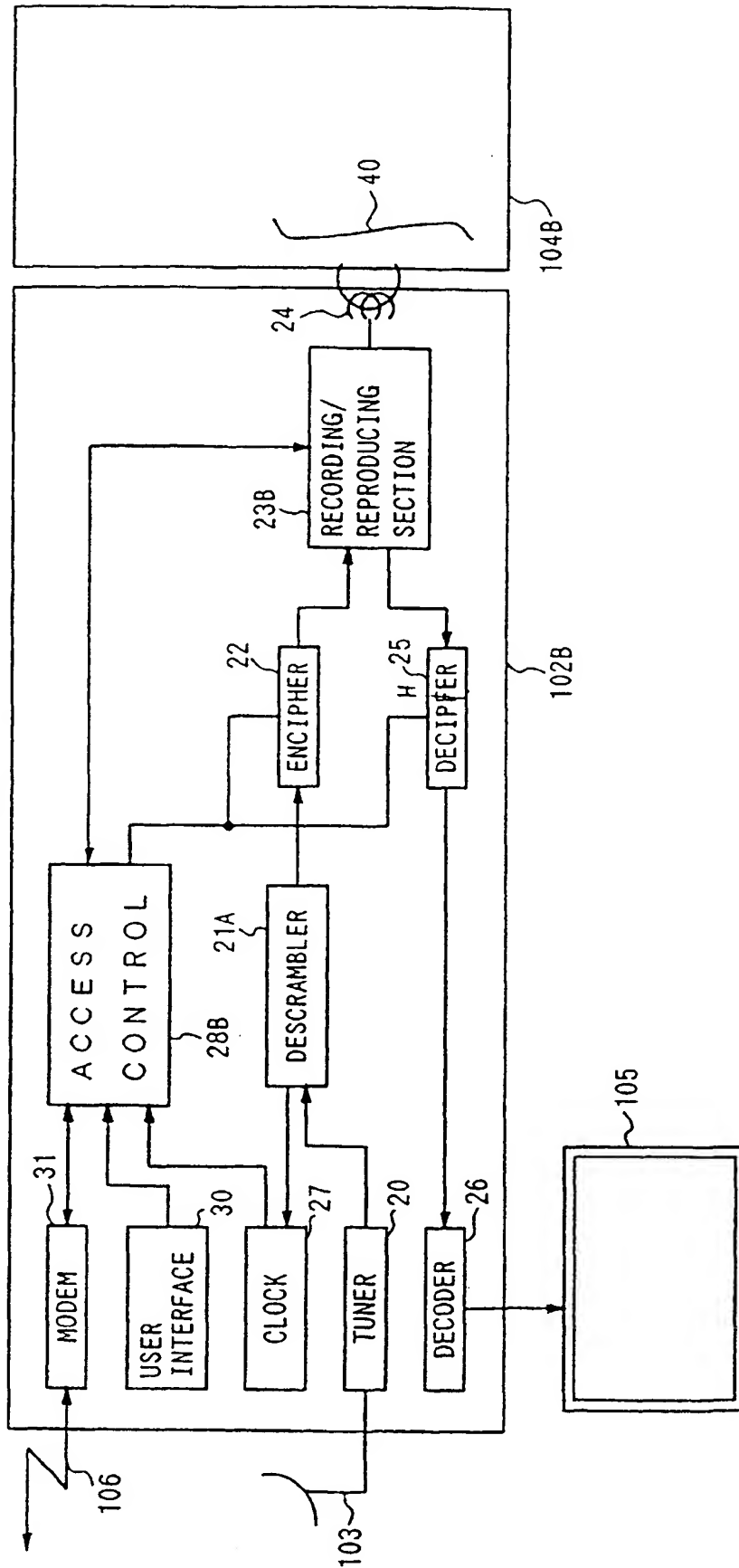


Fig. 5

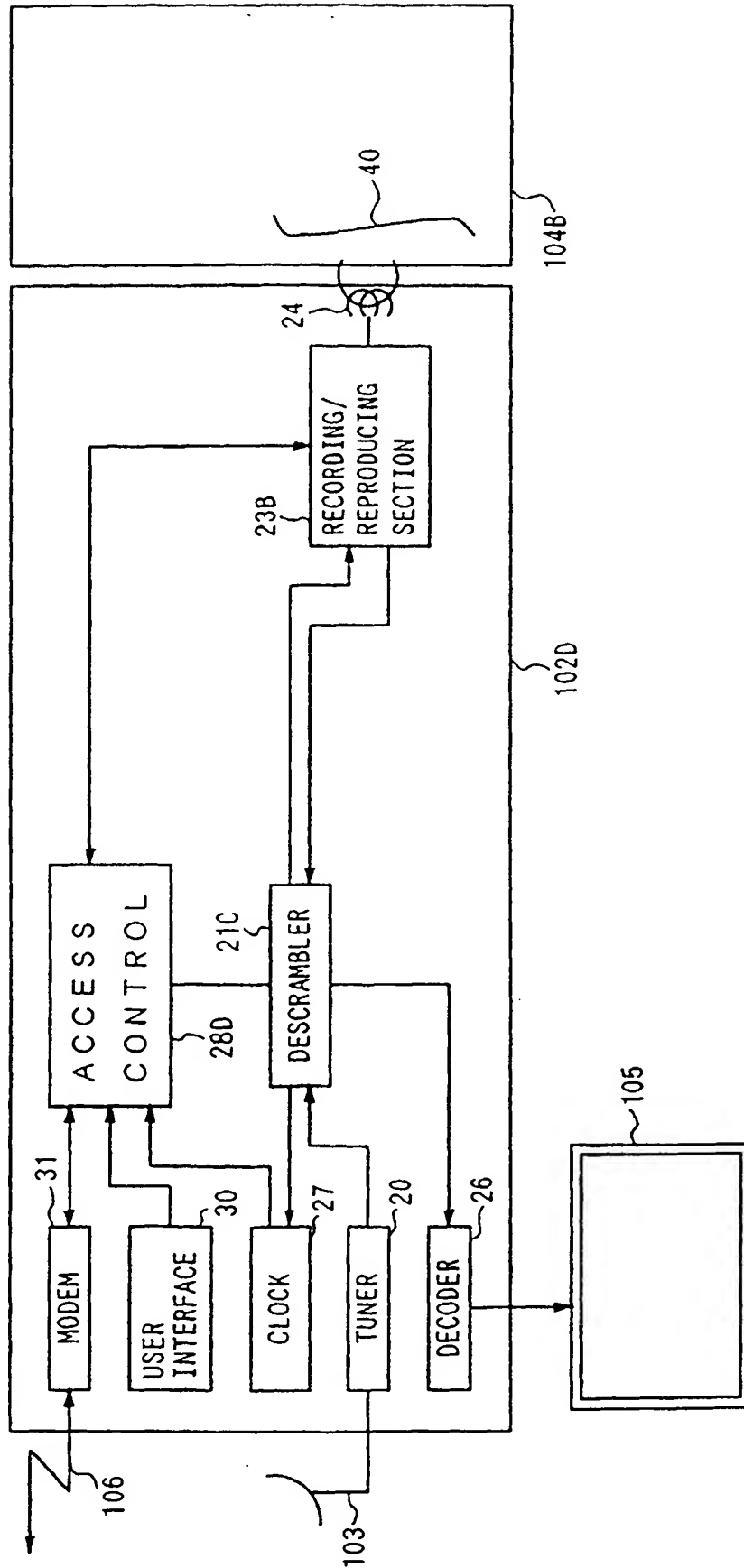
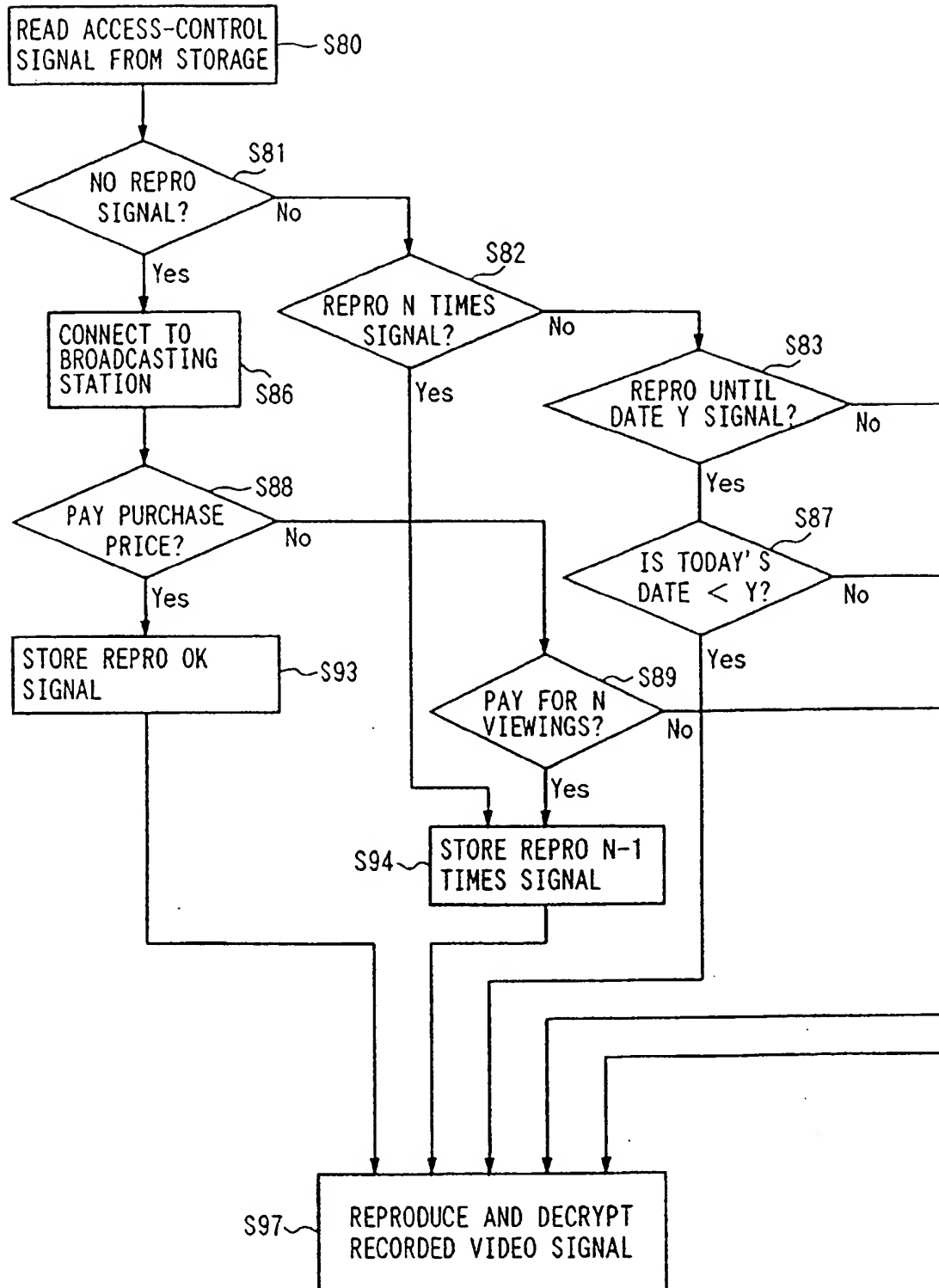
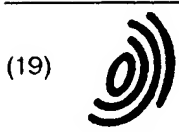


Fig. 7A

Fig. 7

Fig. 7A Fig. 7B





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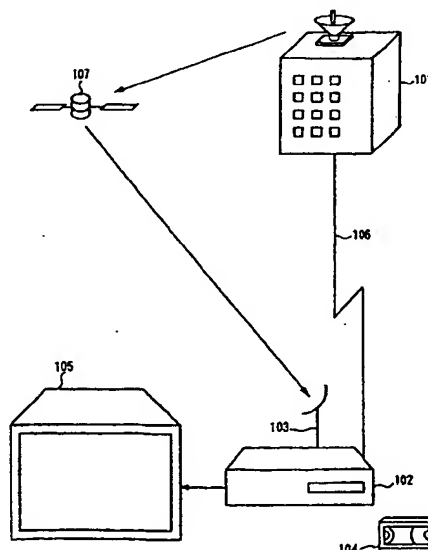
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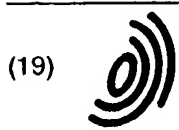
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(54) Receiving controlled-access broadcast signals

(57) An apparatus and method for transferring from a broadcaster (101) to a receiver (102) a limited reproduction right in data. A signal indicating the limited reproduction right is transmitted by the broadcaster (101) and stored (104) by the receiver (102) with the data. The receiver (102) reproduces and processes the data as a function of this signal.

Fig. 1





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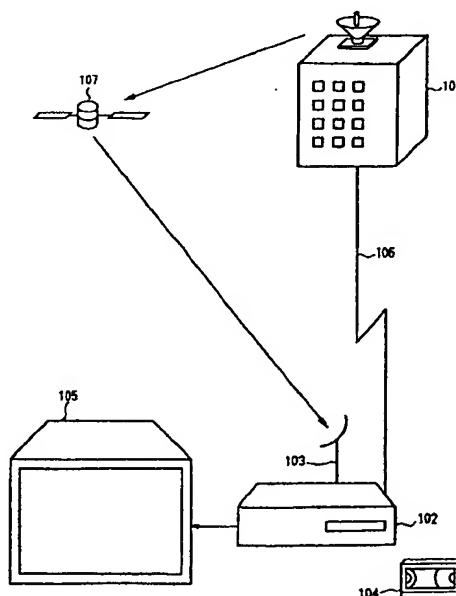
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Fig. 1



optic network or the like.

[0013] Satellite 107 is a satellite broadcast signal relay station that receives signals from broadcasting station 101 and relays the signals to antenna 103. Antenna 103 receives signals from satellite 107 and supplies the signals to receiving system 102. Alternatively, satellite 107 can be replaced by any of a number of other transmission media, such as a land-based broadcast system, a cable television system, a fiber optic network or the like.

[0014] Receiving system 102 receives video signals and access-control signals supplied by broadcasting station 101 and processes (e.g. descrambles, decodes, and records) the signals. Typically, video signals are recorded on a storage medium and subsequently reproduced for display. Alternatively, video signals are recorded on a storage medium and processed for display to a user substantially simultaneously. Access-control signals are stored in a memory or, alternatively, recorded on a storage medium which may be the same storage medium on which the video signals are recorded. In a preferred embodiment, receiving system 102 is adapted to receive a storage cassette 104 containing a tape on which video and access-control signals are recorded. Alternatively, storage cassette 104 comprises a tape for storing video signals and a separate memory, such as a memory chip included therein, for storing access-control signals. In other embodiments, receiving system 102 is adapted to receive any of a number of other storage media, such as a video disc, a magnetic media diskette, a compact disc or the like. Video display 105, which preferably is a conventional display device, is coupled to and receives video signals from receiving system 102 for display to a user.

[0015] In a preferred recording mode of operation, broadcasting station 101 transmits video signals to satellite 107 which relays the signals to antenna 103 from which the video signals are coupled to receiving system 102. Also, broadcasting station 101 transmits access-control signals through communication link 106 to the receiving system. Receiving system 102 processes and records the video signals as a function of the access-control signals.

[0016] In a preferred reproduction mode of operation, the receiving system retrieves the previously stored access-control signals and uses those access-control signals to control the reproduction and processing of the previously recorded video signals. The video signals are supplied to video display 105 or to another peripheral device (not shown).

[0017] An alternate satellite television broadcasting system according to the present invention comprises each of the elements described above except that only one of communication link 106 and satellite 107 is included. The alternate system is otherwise interconnected as in the above-described embodiment. Through the single transmission medium, broadcasting station 101 transmits both video signals and access-control signals to receiving system 102.

[0018] In another variation, receiving system 102 transmits program requests, payment information, or other signals to broadcasting station 101 through one of the transmission media. Typically, communication link 106 is used for this purpose.

[0019] A first embodiment of the controlled-access broadcast digital video signal receiving system 102 according to the present invention is illustrated in Fig. 2 as system 102A. Receiving system 102A, is adapted for receiving, descrambling, enciphering, recording, deciphering and decoding digital video signals; and is comprised of a tuner 20, a descrambler 21A, an encipherer 22, a recording/reproducing section 23A, a decipherer 25, a decoder 26, an access controller 28A, a user interface 30, and a modem 31.

[0020] Tuner 20 receives input digital video signals, selects particular digital video signals, and supplies the selected signals to descrambler 21A. Preferably, input digital video signals are satellite broadcast digital video signals acquired by satellite antenna 103 which is coupled to tuner 20. Alternatively, input digital video signals are acquired from another transmission medium that is coupled to tuner 20. Preferably, a user controls tuner 20 to select signals from among different input digital video signals. The selected video signals include a time reference signal and a date reference signal.

[0021] Descrambler 21A is coupled to tuner 20 and descrambles scrambled digital video signals supplied therefrom. As is well known in the art, transmitted video signals are commonly scrambled or coded by a signal provider to prevent unauthorized reception of the video signals. Descrambler 21A supplies an unscrambled version of the digital video signals to encipherer 22. Further, descrambler 21A is coupled to a clock 27 to supply the received time reference signal and the date reference signal thereto.

[0022] Encipherer 22 is coupled to descrambler 21A, recording/reproducing section 23A, and access controller 28A. When enabled by the access controller, encipherer 22 encrypts, according to an encryption key, descrambled video signals supplied by descrambler 21A to produce encrypted video signals. The encrypted video signals are supplied to recording/reproducing section 23A for recording. However, the encrypted video signals cannot be displayed by ordinary means. It is contemplated that the encryption key is prestored in encipherer 22, or is supplied by access controller 28A, or is included in the video signals or in the access-control signals supplied by broadcasting station 101. When disabled by access controller 28A, encipherer 22 passes descrambled video signals from descrambler 21A directly to section 23A without encryption.

[0023] Recording/reproducing section 23A, through a record/playback head 24, or the like, records on storage medium 40 video signals supplied by encipherer 22. Section 23A, through head 24, also reads previously recorded video signals from storage medium 40 and supplies the reproduced video signals to decipherer 25.

[0033] The configuration of the present invention is compatible with many different sequences of signal transfer between broadcasting station 101 and receiving system 102A. Examples of useful signal transfer sequences, implemented in different modes of operation of the present invention, will be described in detail below. Through the different modes of operation, video programs are securely transferred between a broadcaster and a consumer for recording, but the consumer's ability to display the programs can be subjected to limitations.

[0034] In a first video-on-demand mode, a user enters into user interface 30 a request for a specific video program. User interface 30 transmits this request to access controller 28A, which, in turn, communicates the user's request through modem 31 and communication link 106 to broadcasting station 101. The broadcasting station transmits the requested video program to satellite 107 which relays the video program to antenna 103 and supplies the video signals representing this program to tuner 20. It is expected that several video signals are coupled to tuner 20, which selects the particular video signals comprising the requested video program and supplies these selected video signals to descrambler 21A. The descrambler descrambles these broadcast video signals and supplies a descrambled version of the video signals to encipherer 22. Descrambler 21A also supplies a time reference signal and a date reference signal, which accompany the video program transmission, to clock 27.

[0035] Additionally, broadcasting station 101 communicates access-control signals through communication link 106 and modem 31 to access controller 28A for storage in access condition memory 29. The access-control signals serve to define the conditions or limitations, if any, upon the usage of the requested video program. In general, a user can either purchase or rent a particular video program from a broadcaster. In a prepayment method of purchase, a user pays for a video program and subsequently requests that the broadcaster transmit the program to the user's video receiving system. Broadcasting station 101 transmits the requested program and an access-control signal indicating that the video program can be unconditionally recorded and reproduced (FULL ACCESS). Access controller 28A stores the FULL ACCESS signal in access condition memory 29 to disable encipherer 22. Hence, descrambled video signals of the video program are supplied by descrambler 21A through encipherer 22, without encryption, to recording/reproducing section 23A, whereat the descrambled and unencrypted video signals are recorded on storage medium 40.

[0036] In a postpayment method of purchase, wherein a user elects to pay for a video program after it has been received by the user's receiving system, broadcasting station 101 transmits the particular video program to receiving system 102A along with an access-control signal indicating that the video program cannot be

reproduced (NO REPRO). Access controller 28A stores the NO REPRO signal in access condition memory 29 and enables encipherer 22, causing it to encrypt, according to an encryption key, descrambled video signals of the video program supplied by descrambler 21A. Encipherer 22 supplies encrypted video signals to recording/reproducing section 23A, whereat the encrypted video signals are recorded on storage medium 40.

[0037] It is contemplated that the user subsequently purchases the video program from the broadcaster. Upon payment, broadcasting station 101 transmits an access-control signal to access controller 28A indicating that the recorded video program can be reproduced (REPRO OK), and this REPRO OK signal replaces the previously stored NO REPRO signal in memory 29. When the encrypted video signals subsequently are played back from storage medium 40, they are supplied to decipherer 25 which is enabled by the stored REPRO OK signal to decrypt the reproduced video signals.

[0038] In a second prepayment method of purchase, similar to the postpayment method, the user pays for the selected program prior to its transmission, but broadcasting station 101 first transmits the selected program to receiving system 102A along with a NO REPRO signal. Access controller 28A causes encipherer 22 to encrypt the video signals of the video program and the encrypted signals are recorded on storage medium 40 while the NO REPRO signal is stored in access condition memory 29. Upon completion of the video program transmission, broadcasting station 101 transmits a REPRO OK signal; and access controller 28A replaces the stored NO REPRO signal with the REPRO OK signal. Thus, the video program is recorded in encrypted form but the user can reproduce and decrypt the program an unlimited number of times. This second prepayment method has the advantage of producing video recordings that can only be reproduced in devices having compatible decryption capabilities.

[0039] Alternatively, a user can purchase the right to reproduce a video program a certain number (N) of times. The user thus "rents" the video program for N reproductions. In one mode, the user enters a request into user interface 30 to rent a video program for N reproductions. User interface 30 transmits the request to access controller 28A which forwards the request through modem 31 and communication link 106 to broadcasting station 101. Broadcasting station 101 transmits the requested video program along with an access-control signal indicating that the video program can only be reproduced N times (REPRO N TIMES). The access controller receives the REPRO N TIMES signal and stores it in access condition memory 29. The video program is received by tuner 20 and supplied to descrambler 21A which descrambles the video program and supplies descrambled video signals to encipherer 22. The encipherer, which is enabled by the access controller, encrypts the descrambled video signals, and

medium 40.

[0050] Subsequently, but prior to date Y, the user selects a video program from the requested video programming stored on storage medium 40 and pays the fee to rent the selected program for a particular rental term. Upon payment, broadcasting station 101 transmits the access-control signal indicating the appropriate rental condition to access controller 28A which replaces the previously stored NO REPRO signal in memory 29. Hence, the ERASE ON DATE Y signal remains stored in access condition memory 29.

[0051] Illustrative video signal reproduction modes of operation of receiving system 102A now will be described. The process is initiated when a user enters a command into user interface 30 to reproduce a prestored video program recorded on storage cassette 104A. The user interface transmits the command to access controller 28A which retrieves the access-control signal stored in access condition memory 29 of the storage cassette. The operation of decipherer 25 is controlled as a function of the particular access-control signal(s) that is retrieved.

[0052] If, for example, the retrieved signal is a FULL ACCESS signal, then access controller 28A disables decipherer 25. Recording/reproducing section 23A recovers video signals from storage medium 40 and supplies the reproduced video signals to decipherer 25, which passes the video signals to decoder 26. As described above, the reproduced video signals are unencrypted; and decoder 26 decodes the video signals and supplies uncoded video signals to video display 105.

[0053] If the NO REPRO signal is retrieved from access condition memory 29, access controller 28A disables the operation of decipherer 25. However, unlike the FULL ACCESS signal case, the video signals stored on storage medium 40 are encrypted. Hence, recording/reproducing section 23A reproduces encrypted video signals which are supplied to decipherer 25 to be passed directly to decoder 26 without decryption. The decoder decodes the encrypted video signals to produce uncoded but encrypted video signals which are supplied to video display 105. As a result, the video display either cannot display the video signals at all or can only display a distorted version of the original video program.

[0054] As a further alternative, access controller 28A may retrieve a REPRO OK signal from access condition memory 29 to enable the operation of decipherer 25. Recording/reproducing section 23A reproduces the encrypted video signals stored on storage medium 40 and supplies the encrypted signals to enabled decipherer 25 which decrypts the video signals and supplies unencrypted video signals to decoder 26. The decoder decodes the video signals and supplies the resulting uncoded and decrypted video signals to video display 105 for display. Because the video signals are uncoded and decrypted, video display 105 displays the repro-

duced video program without distortion.

[0055] As yet another alternative, when access controller 28A retrieves a REPRO N TIMES signal from access condition memory 29, the access controller 28A determines whether the number N is greater than a predetermined threshold value (e.g. zero). If the number N is not greater than the threshold value, then access controller 28A disables operation of decipherer 25 and reproduction of the stored video signal proceeds as in the NO REPRO signal case. On the other hand, if the number N is greater than the threshold value, then access controller 28A enables decipherer 25 and reproduction of the stored video signal proceeds as in the REPRO OK signal case.

[0056] After the video signal is reproduced from storage medium 40, if the number N is greater than the threshold value, access controller 28A subtracts one from the value of N to produce a new value N and writes a new REPRO N TIMES signal, utilizing the new value N, into access condition memory 29 whereat the previously stored REPRO N TIMES signal is replaced by the new REPRO N TIMES signal. According to this procedure, the particular video signals stored in storage medium 40 to which the REPRO N TIMES signal corresponds are only reproduced the number of times represented by the number N. The value N stored in access condition memory 29 thus reflects the remaining number of permitted reproductions of the particular video signals. Since the access condition memory is provided in the same storage cassette 104A as storage medium 40, and the video signals are encrypted on the storage medium, the video signals can only be reproduced for display N times even if the cassette is loaded into another receiving system, at least until a new access-control signal is stored.

[0057] When, as described above, a video program is rented for only a certain period of time, access controller 28A retrieves the corresponding access-control signal from access condition memory 29 and also receives a clock signal and a date signal from clock 27. The clock signal and the date signal are compared to the retrieved access-control signal, and if the particular condition expressed in the access-control signal is satisfied such that reproduction is allowed, then decipherer 25 is enabled and reproduction of the stored video signals proceeds as in the REPRO OK case. However, if the condition expressed by the access-control signal is not satisfied such that reproduction of the video signals is not allowed, then the decipherer is disabled and reproduction of the stored video signals proceeds as described with respect to the NO REPRO signal.

[0058] For example, when access controller 28A retrieves a REPRO UNTIL DATE Y signal from access condition memory 29, it compares the date signal from clock 27 to the date Y. If the date from clock 27 is prior to date Y, then the access controller enables the operation of decipherer 25 to decrypt the reproduced, encrypted video signals. In a similar fashion, when the

broadcast digital video signal receiving system 102C according to the present invention is illustrated in Fig. 4. Receiving system 102C, is adapted for receiving, descrambling, decoding, recording, and reproducing digital video signals and is similar to the aforescribed receiving system 102A of Fig. 2. As in receiving system 102A, receiving system 102C stores access-control signals in access condition memory 29 of storage cassette 104A, while the video signals are stored on storage medium 40 of the storage cassette.

[0069] Fig. 4 differs from Fig. 2 in that descrambler 21C of receiving system 102C is coupled to access controller 28C, recording/reproducing section 23A, and decoder 26; and encipherer 22 and decipherer 25 are not provided as separate circuits. When enabled by access controller 28C, descrambler 21C descrambles video signals supplied by tuner 20 and supplies an unscrambled version of the digital video signals to recording/reproducing section 23A. Also, when enabled by the access controller, descrambler 21C descrambles video signals reproduced by recording/reproducing section 23A and supplies an unscrambled version of the digital video signals to decoder 26. When disabled by access controller 28C, descrambler 21C passes scrambled video signals from tuner 20 directly, without encryption, to section 23A and also passes video signals reproduced by the recording/reproducing section directly, without decryption, to decoder 26. Scrambled video signals can be recorded but they cannot be displayed in scrambled form.

[0070] It will be appreciated that access controller 28C functions in the same general manner as access controller 28A, except that descrambler 21C is controlled in accordance with the access-control signals rather than encipherer 22 and decipherer 25.

[0071] At those aforescribed operational steps where access controller 28A enables encipherer 22, access controller 28C disables descrambler 21C to pass scrambled signals to the recording/reproducing section; and where access controller 28A disables encipherer 22, access controller 28C enables descrambler 21C to supply descrambled signals to the recording/reproducing section. However, in the operational steps where access controller 28A enables decipherer 25, access controller 28C similarly enables descrambler 21C to descramble the signals reproduced by the recording/reproducing section. Where access controller 28A disables decipherer 25, access controller 28C similarly disables descrambler 21C to pass to decoder 26 signals reproduced by the recording/reproducing section.

[0072] In an alternate embodiment of receiving system 102C, access-control signals, transmitted by broadcasting station 101 along with video signals, are received through antenna 103 and supplied by tuner 20 to descrambler 21C for descrambling and for coupling to access controller 28C.

[0073] A still further embodiment of the controlled-

access broadcast digital video signal receiving system 102D according to the present invention is illustrated in Fig. 5. Receiving system 102D is seen to be a combination of portions of receiving system 102C and receiving system 102B (Fig. 3). Similar to receiving system 102B, receiving system 102D stores access-control signals and video signals in the same storage medium 40 of storage cassette 104B. Recording/reproducing section 23B supplies the reproduced video signals to descrambler 21C and supplies the reproduced access-control signals to access controller 28D.

[0074] It will be appreciated that the modes of operation of receiving system 102D are substantially similar to the modes of operation of receiving system 102C with the following illustrative exceptions. Access controller 28D functions in the same manner as access controller 28C, except that access-control signals are stored in storage medium 40 instead of in a separate access condition memory. Recording/reproducing section 23B functions in the same manner as section 23A except that section 23B additionally records access-control signals on and reproduces access-control signals from storage medium 40. The reproduced access-control signals are supplied from recording/reproducing section 23B to access controller 28D.

[0075] Similar to the alternate embodiment discussed in conjunction with Fig. 4, access-control signals, transmitted by broadcasting station 101 along with video signals, are received through antenna 103 and supplied by tuner 20 to descrambler 21C for descrambling; and the descrambled access-control signals are supplied to access controller 28D. It is seen that access controller 28D receives access-control signals from recording/reproducing section 23B and either from modem 31 or from descrambler 21C, or from both.

[0076] Fig. 6 is a flow diagram of a preferred mode of operation of receiving system 102A of Fig. 2, as controlled by access controller 28A, wherein a user orders from a broadcaster a limited or an unlimited right (as may be desired) to reproduce a video program. The user initiates the process by entering a request for a particular video program at user interface 30. The process begins at step S60, where access controller 28A causes modem 31 to connect to broadcasting station 101.

[0077] Access controller 28A transmits identification information through modem 31 and communication link 106 to broadcasting station 101 which checks the identification information against a subscription list and determines whether the user has subscribed to the broadcasting station's service, as represented by inquiry S61. If the user is not subscribed, the broadcasting station terminates the connection with receiving system 102A in step S62.

[0078] If the user is subscribed, inquiry S61 is answered in the affirmative and operation continues to inquiry S63, which polls the user to determine whether or not the video program is to be purchased. If the user

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